

OBSERVATIONS ON SOME MATINAL BEES AT FLOWERS OF CUCURBITA, IPOMOEIA AND DATURA IN DESERT AREAS OF NEW MEXICO AND SOUTHEASTERN ARIZONA

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Although some of the crepuscular and nocturnal bees which collect their pollen during the evening hours have received considerable study [for a summary, see Linsley (1958)] little serious attention has been given to matinal species until recent years [Michener (1947); Linsley, MacSwain and Smith (1955a, 1955b, 1956); Linsley and MacSwain (1956); MacSwain (1957); Linsley and Hurd (1959)]. The bees involved fall into two classes: (1) oligolectic species which are closely synchronized with the periods of pollen availability in their host plant (*Lasioglossum lustrans* Cockerell, certain anthophorids, some *Andrena*), and (2) polylectic species which, when conditions permit, extend their foraging activity into the early morning hours and offer competition to the matinal oligoleges (some anthophorids; *Agapostemon* and a few other halictines; carpenter bees; bumblebees; and honey bees).

The following observations, although fragmentary, are intended to contribute to our knowledge of the general subject of matinal bees. They were made primarily in the vicinity of the Southwestern Research Station of the American Museum of Natural History, near Portal, Arizona. The writer is indebted to Dr. Mont A. Cazier, Director, for making the facilities of the station available as a base for these and related studies.

Cucurbita

The most conspicuous North American oligolectic bees associated with *Cucurbita* belong to the closely related eucerine genera of anthophorids, *Xenoglossa* Smith and *Peponapis* Robertson. Cockerell (1896) was one of the first to call attention to this relationship. At 9 a.m. on June 21, 1896, he opened fresh flowers of *Cucurbita perennis* growing at Mesilla, New Mexico and found

males (one to a flower) representing three species now known as *Peponapis pruinosa pruinosa* (Say), *Xenoglossa patricia* Cockerell, and *X. strenua strenua* (Cresson). On the following day he examined the flowers earlier (at 7:45 a.m.) and again captured a number of males, along with one female of *X. patricia* and four females of *X. s. strenua*. Cockerell did not mention whether the females were gathering pollen but it is likely that they had already completed this activity [Robertson (1925) reported *P. p. pruinosa* visiting *Cucurbita pepo* before sunrise in Illinois; Linsley, MacSwain, and Smith (1955a) found *X. fulva* Smith active at dawn in Mexico].

Although the eucerine anthophorids were the predominant bees found at *Cucurbita* by Cockerell, he reported the presence of honey bees, which "seemed disconcerted to find fat *Xenoglossae* at the bottom" of the flowers, as well as *Agapostemon texanus* Cresson. Robertson reported six additional species of bees at *C. pepo* in Illinois and Fronk and Slater (1956) found a number of others, mostly halictines, visiting *Cucurbita maxima*, and to a lesser extent *C. pepo*, in Iowa. In addition, these authors record *X. s. strenua* and *P. p. pruinosa* from the related cucurbit *Lagenaria siceraria*.

During the summer of 1959, near Portal, Arizona and Rodeo, New Mexico, four species of eucerine anthophorids were found visiting *Cucurbita* but not more than two were found together at any one site. Two orange-flowered species of *Cucurbita* were involved, *C. foetidissima* and *C. digitata*. The yellow-flowered *Apodanthera undulata*, which grew along with them, was not visited by bees of any kind while it was under observation.¹ Notes from the three principal sites may be summarized as follows:

Southwestern Research Station, Chiricahua Mountains, 5 miles west of Portal, Arizona. At this site *Cucurbita foetidissima* was growing in a dense patch from 40–50 feet in diameter near the

¹ It is interesting to note that in the Salt River Valley of Arizona, cantaloup flowers open between 7 and 8 a.m. McGregor and Todd (1952) found that honey bees were the only pollinators present in that area and without them commercial production of cantaloups was impossible. Their activity began shortly before noon. Possibly the late opening of the flowers explains the absence of native bees, or perhaps, as in the case of *Apodanthera*, the flowers are not attractive to them.

main laboratory building and in smaller, scattered clumps elsewhere. On July 18, the flowers were examined at 5 a.m. MST (Temperature: 52° F). Between 75 and 80 flowers were open and female *Peponapis p. pruinosa* (Say) were actively gathering pollen. They were joined at 5:35 a.m. by a honey bee and a female of *Agapostemon angelicus* Cockerell. By 5:55 a.m. (Temperature: 54° F) a second honey bee had appeared and *Peponapis* activity had fallen off markedly. During the next hour a few females returned for nectar but no males were noted until 7 a.m.

At the same site three days later, the first females of *Peponapis* were gathering pollen at 4:55 a.m. (Temperature: 59° F). It was too dark to see them without a flashlight, but they could be followed readily because of their loud buzzing. By 5:05 a.m., the flying bees could be distinguished but there was not yet enough light to see into the flowers. At 5:10 a.m. the bees could be seen in the flowers and their buzzing fell off noticeably. The first honey bee appeared at 5:19 a.m., and at 5:25 a female of *Xenoglossa patricia* Cockerell was taking pollen. By this time, pollen-collecting *Peponapis* had largely disappeared (one straggler was found at 5:37 a.m.) and honey bees were becoming more abundant. Observations were terminated at 6:15 a.m. without the appearance of males of either *Peponapis* or *Xenoglossa*. A check of the flowers at 9 a.m. yielded a few males in the flowers facing outward.

On July 28, the flowers were examined at 4:30 a.m. At 4:50 (Temperature: 64° F) *Peponapis* were heard flying and identified by flashlight. By 5:04 a.m. they could be seen without the light. The first honey bee appeared at 5:15 a.m. and female *Xenoglossa* were collecting pollen at 5:22 and 5:23 a.m. The last *Peponapis* with a load of pollen was seen at 5:47 a.m. By this time honey bees were abundant.

The importance of honey bees in cucurbit pollination is a subject upon which there is a diversity of opinion [Fronk and Slater (1956)]. Since none were seen at other localities, observations were made only at the above site, where the bees are naturalized, living in hollow trees, etc. On July 18, 21, and 28, the first honey bees appeared at *Cucurbita* flowers at 5:35 a.m. (Temperature: 53° F), 5:19 a.m. (Temperature: 58° F), and 5:15 a.m.

(Temperature: 64° F) respectively, in each case about the time pollen collecting by *Peponapis* began to fall off. They extracted pollen from the flowers with great difficulty, scraping it from the stamens in small amounts with the front legs. After each scraping the bees left the flower, poised on the wing in front of it for 10–15 seconds and transferred the pollen to the hind legs before re-entering. After repeating this procedure several times, the bees usually rested on the flower lip, or on a leaf, and worked the pollen into the load before moving to another blossom. At other times they crawled over the leaves or rested with the abdomen pumping. Most of the honey bees carried very small pollen loads in contrast to those of *Peponapis* and *Xenoglossa*. Possibly this was because they followed these anthophorids, as pollen scavengers.

At a second site, two miles northeast of Portal, a few plants of *Cucurbita foetidissima* were growing on a bank. It was not possible to visit this site at dawn, but the few available flowers were examined twice at about 9 a.m. On August 2, wilted flowers contained three males of *Xenoglossa patricia* Cockerell and two of *X. s. strenua* Cresson. The following day they yielded two males and two females of *X. patricia* (the females without pollen), a male of *X. s. strenua* and a female of *Agapostemon melliventris* Cresson (without pollen).

The third locality was five miles south of Rodeo, New Mexico, where a few plants of *Cucurbita foetidissima* were growing along the roadside intermixed with the somewhat smaller flowered *C. digitata* and the yellow flowered *Apodanthera undulata*. *Xenoglossa patricia* collected pollen before sunrise from both species of *Cucurbita* but not from *Apodanthera*. On July 31, the site was visited at 5 a.m. (Temperature: 60° F). *Xenoglossa* females were actively collecting pollen and continued to do so until 6:40 a.m., 50 minutes after sunrise. Males first appeared at 5:15 a.m. and cruised the flowers as long as females were active. Females of *Agapostemon melliventris* began gathering pollen at 5:13 a.m. and were fairly numerous until the pollen began to run out about 6:30 a.m. A male of an undescribed species of *Peponapis* was cruising at 6:12 a.m., but no females appeared.

On August 4, the site was visited at 4:45 a.m. (Temperature 55° F). Few flowers were open and the sky was overcast and

threatening rain. Females of *X. patricia* and *A. melliventris* were already actively gathering pollen but by 5:15 a.m., 42 minutes before sunrise, the pollen was exhausted. A few females of *Xenoglossa* took nectar from the flowers until about 6 a.m., and males continued to cruise and take nectar during this same period. At 5:47, a female without pollen tested the soil at the edge of the road for about 10 minutes in search of a suitable nest site, but she flew off without starting an excavation.

At the two very different sites where five complete flight counts were taken (5 miles West of Portal and 5 miles South of Rodeo), the initiation of pollen gathering activity for *Xenoglossa* and/or *Peponapis* only varied from 4:50 a.m. to 5:04 a.m., although the air temperatures ranged from 52° F to 64° F. On these same days, the arrival time of the first polylectic pollen collectors, *Apis* and/or *Agapostemon* lagged on the average by nearly 24 minutes. The greatest lag, 35 minutes, occurred when the air temperature was lowest (52° F) when the flight of *Peponapis* started.

Ipomoea

The genus *Ipomoea* (*Convolvulaceae*) contains numerous species which make their pollen available very early in the morning. The principal pollinators reported thus far are oligolectic bees, including *Ptilothrix sumichrasti* (Cresson) [Linsley, MacSwain and Smith (1956)] and various species of *Melitoma* [Robertson (1925); Michener (1951); Linsley, MacSwain and Smith (1956)]. Little has been published regarding the pollen collecting activities of these bees, although Robertson observed *Melitoma taurea* (Say) visiting *Ipomoea* flowers before dawn in Illinois.

Melitoma grisella (Cockerell and Porter) is also a matinal pollen collector. On July 13, 1959, at 7:15 a.m. MST (Temperature: 70° F), near Los Montoyas, New Mexico, this species was very abundant about the blue-flowered *Ipomoea leptophylla* Torrey. However, by this time all of the pollen had been removed from the stamens. A few females were visiting the blossoms for nectar and relatively large numbers of males were cruising the flowers. The males flew very rapidly, occasionally popping in and out of flowers. During the next two hours,

large numbers of solitary bees and honey bees were observed taking nectar from *Melilotus alba* in the vicinity of *Ipomoea*, but these did not include either sex of *Melitoma*. Conversely, only one species which was taking nectar from *Melilotus* was also found on flowers of *Ipomoea*, a female *Svastra*. Three other bees, two males of *Diadasia* which had apparently strayed from nearby plants of *Sphaeralcea* where their females were gathering pollen, and a male of the *Oenothera* oligolege *Chloralictus* (*Sphecodogastra*) *texanum* (Cresson), also visited *Ipomoea* during this period. This provided a marked contrast to the intense activity of *Melitoma*.

A beetle competitor, *Euphoria kerni* Haldeman, like its Mexican counterpart *E. basalis* Gory & Percheron, feeds on the floral parts of *Ipomoea* and interferes with pollination. The leaves of *I. leptophylla* were also heavily infested with adults and larvae of the chrysomelid *Chelymormpha cassidea* (Fabricius), less heavily with *Metriona bicolor* (Fabricius).

Datura

Apparently, very few bee visitors have been reported for any of the native or naturalized species of *Datura* (*Solanaceae*) which grow in the desert areas of southwestern United States and northern Mexico. Cockerell and Porter (1899) captured the matinal colletid *Caupolicana yarrowi* (Cresson) at *Datura* flowers between 5:15 and 6:15 a.m., but did not indicate whether or not pollen was being collected. Graenicher (1930) records a female of this species at flowers of *Antigonum* (without stating whether it was taking pollen) and Linsley and Hurd (1959) found males at Granite Pass, New Mexico taking nectar from flowers of *Larrea divaricata* Cav. before sunrise. Near Portal, Arizona in early August, I found them visiting *Melilotus alba* under similar circumstances but was unable to locate the pollen source (or sources) of the female. According to Michener (1951) the species is not oligolectic.

Most species of *Datura* have large, conspicuous, white or purplish-white flowers and make their pollen available in the evening. At a series of localities in the vicinity of Portal, Arizona and Rodeo, New Mexico, I twice examined flowers in the early evening without finding any pollinating insects, although al-

leculid beetles were usually present along with scarabs of the species *Cyclocephala* (*Dichromina*) *dimidiata* Burmeister. These fly to the flowers shortly after they open in the evening and remain in them until they wilt the following day. Both are nectar feeders and although they block the area of the nectaries they usually remain below the stamens and do not interfere with pollination. Bees visit the flowers in the early morning, but by that time the pollen is largely gone (removed by sphinx moths?).

On July 17, 1959, at Granite Pass, New Mexico, blossoms were examined by flashlight at 4:56 a.m. The air temperature at that time was 70° F and females of *Agapostemon melliventris* Cresson and worker honey bees were taking nectar and scavenging for pollen. During the next 15 minutes they were joined by several females of *Xylocopa californica arizonensis* Cresson and workers of *Bombus sonorus* Say, each of which seemed to be seeking nectar, but by 5:15 a.m. activity had fallen off and only a few honey bees remained, crawling over the dry stamens. By the time the sun rose at 5:32 a.m. all activity had ceased.

On July 31, 1959, 5 miles south of Rodeo, New Mexico, *Datura* flowers were again examined by flashlight shortly after dawn. At 4:30 a.m. (Temperature: 60° F), there was no insect activity, although the pollen was practically all gone from the stamens. The air temperature remained fairly steady until the sun rose at 5:50 a.m. By 6 a.m. it was 64° F and females of *Agapostemon melliventris* Cresson began to appear and scavenge for pollen. By 6:15 a.m. (Temperature: 66° F) males and females of *Agapostemon* were active about the flowers, the females primarily seeking nectar, but after 6:30 a.m. their numbers fell off very rapidly.

The contrast in the activity periods of the bees on these two days suggests that temperature may be a greater limiting factor than light intensity for polylectic species which are not primarily adapted for visiting flowers during the early morning hours.

Literature cited

- COCKERELL, T. D. A. 1896 New bees of the genera *Xenoglossa* and *Podalirius* (*Anthophora*). Canadian Ent. 28: 191-197.
- COCKERELL, T. D. A. AND W. PORTER. 1899. Contributions from the New Mexico Biological Station. VII Observations on bees, with descriptions of new genera and species. Ann. Mag. Nat. Hist. (7)4: 403-421.

- FRONK, W. D. AND J. A. SLATER. 1956. Insect fauna of cucurbit flowers. Jour. Kansas Ent. Soc. 29: 141-145.
- GRAENICHER, S. 1930. Bee-fauna and vegetation of Miami, Florida. Ann. Ent. Soc. Amer. 23: 153-174.
- LINSLEY, E. G. 1958. The ecology of solitary bees. Hilgardia. 27: 543-599.
- LINSLEY, E. G. AND P. D. HURD. 1959. Ethological observations on some bees of Southeastern Arizona and New Mexico (Hymenoptera). Ent. News 70: 63-68.
- LINSLEY, E. G. AND J. W. MACSWAIN. 1956. Further notes on the taxonomy and biology of the andrenine bees associated with *Oenothera*. Pan-Pacific Ent. 32: 111-121.
- LINSLEY, E. G., J. W. MACSWAIN AND R. F. SMITH. 1955a. Biological observations on *Xenoglossa fulva* Smith with some generalizations on biological characters of other eucerine bees (Hymenoptera, Anthophoridae). Bull. Southern Calif. Acad. Sci. 54: 128-141.
- . 1955b. Observations on the nesting habits and flower relationships of some species of *Melandrena* (Hymenoptera, Andrenidae). Pan-Pacific Ent. 31: 173-186.
- . 1956. Biological observations on *Ptilothrix sumichrasti* (Cresson) and some related groups of emporine bees. Bull. So. Calif. Acad. Sci. 55(2): 83-101.
- MACSWAIN, J. W. 1957. The flight period of *Martinapis luteicornis* (Cockerell) (Hymenoptera: Apoidea). Pan-Pacific Ent. 33: 70.
- MCGREGOR, S. E. AND F. E. TODD. 1952. Cantaloup production with honey bees. Jour. Econ. Ent. 45(1): 43-47.
- MICHENER, C. D. 1947. Some observations on *Lasioglossum* (*Hemihalictus*) *lustrans* (Hymenoptera, Halictidae). Jour. New York Ent. Soc. 55: 49-50.
- . 1951. In: Muesebeck, Krombein and Townes, *Hymenoptera of America north of Mexico—synoptic catalogue*. U. S. Dept. Agr. Monogr. 2. 1420 pp.
- ROBERTSON, C. 1914. Origin of oligotropy of bees. Ent. News 25: 67-73.
- . 1925. Heterotropic bees. Ecology 6(4): 412-436.